Consistency Assessment of AIRS and IASI Radiances

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Acknowledgements

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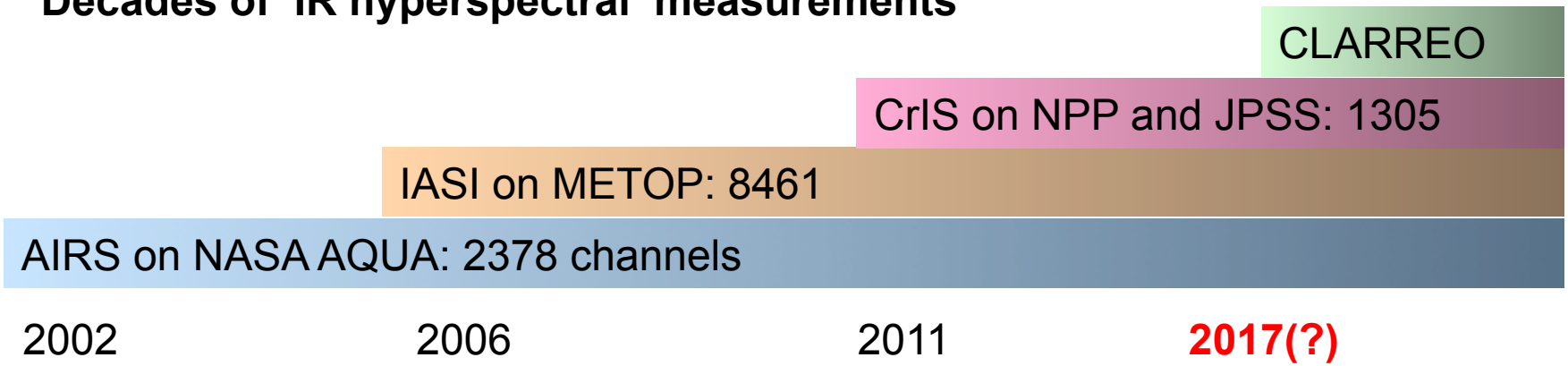
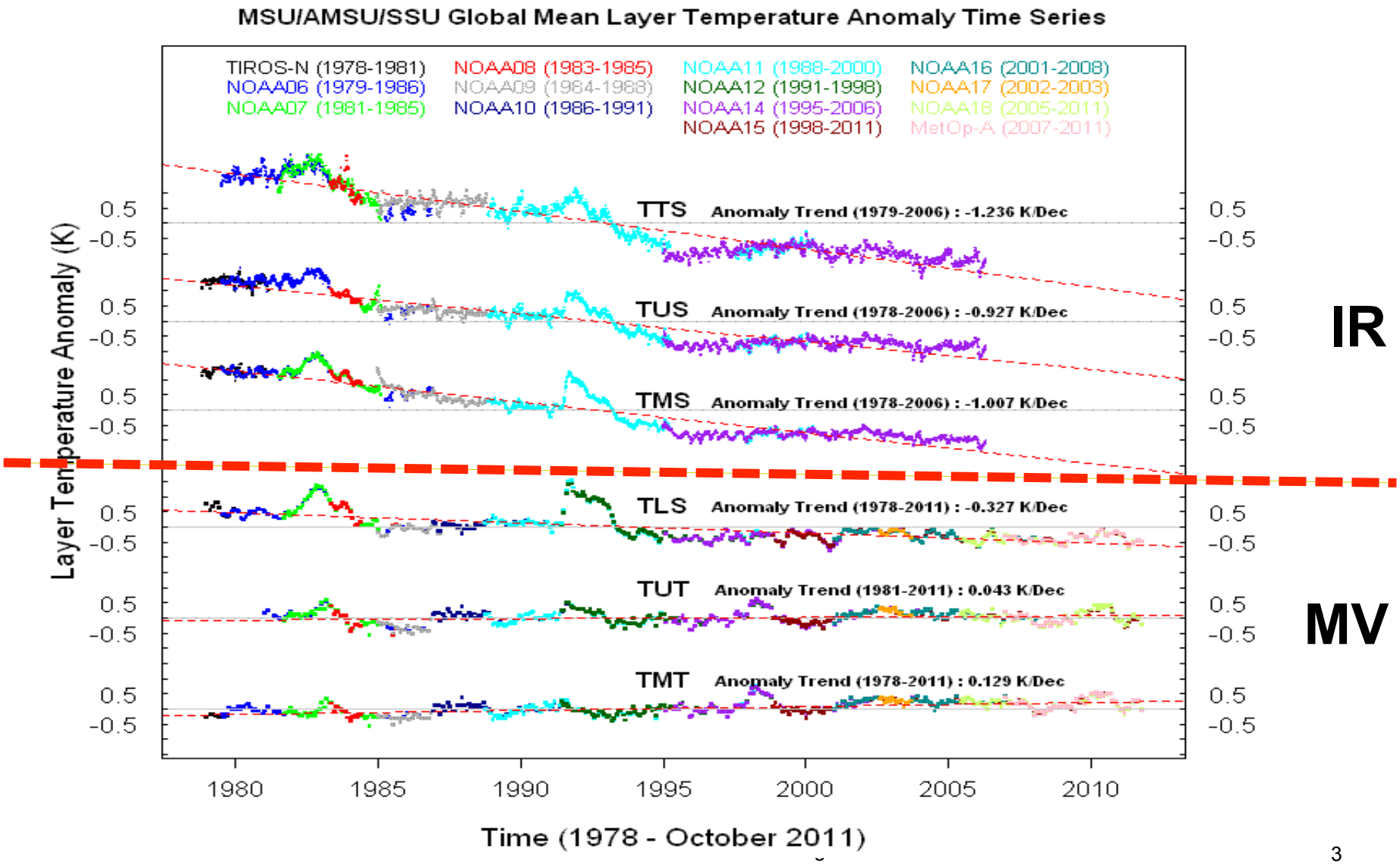
Motivation

Decades of IR hyperspectral measurements



- **Question1:** **Do we understand the radiometric differences among these instruments?**
- **Question 2:** **How do these differences changes along time at different climate regions?**

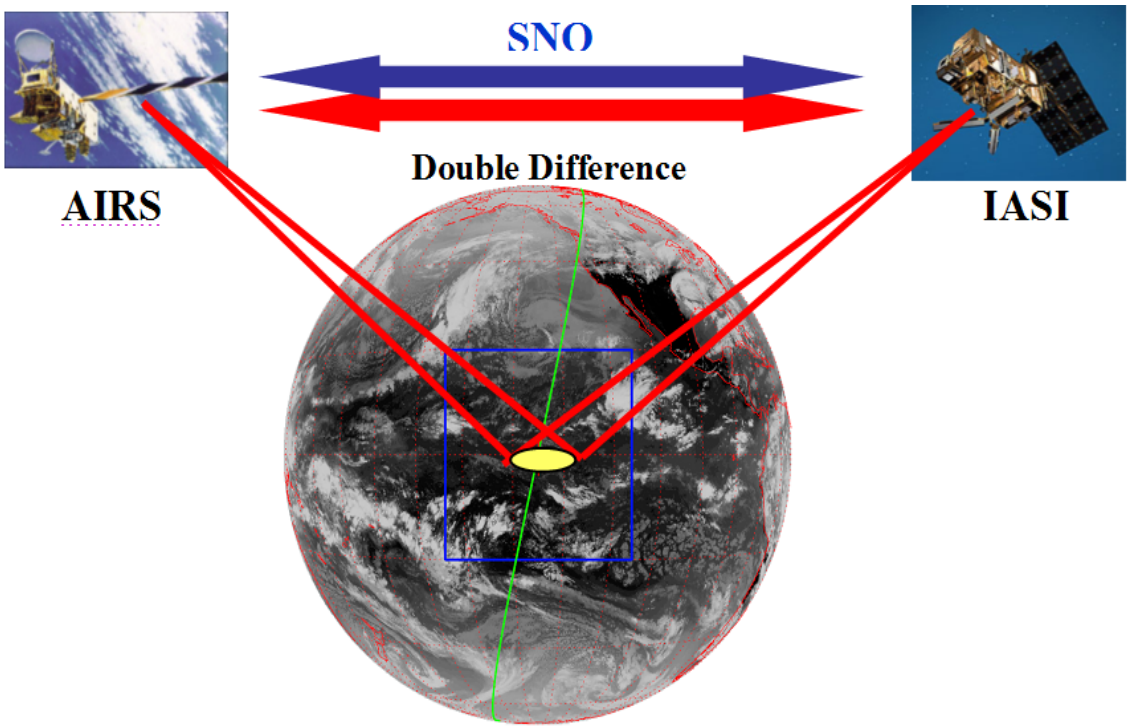
Linking SSU, AIRS, and IASI



Comparison Method

- SNO *vs.* Double differences
  - Simultaneous Nadir Overpass
    - Direct comparison at the Polar Regions
  - Double Differences
    - Using a transfer target
      - Geostationary radiometer (GOES imager) **(NOAA)**
      - Land or sea surface temperatures (JPL)
      - Radiative calculations (UMBC)
    - Differences of AIRS and IASI relative to a transfer target
    - Extending the comparison into different climate regions
- Spectral vs. Integration
  - Spectral method: the finest spectral scale (UMBC and UW)
  - Integration method: relatively large wavelength intervals (NOAA)
  - Single channel method (JPL)

GSICS Framework:
- Independent Calibration Assessment

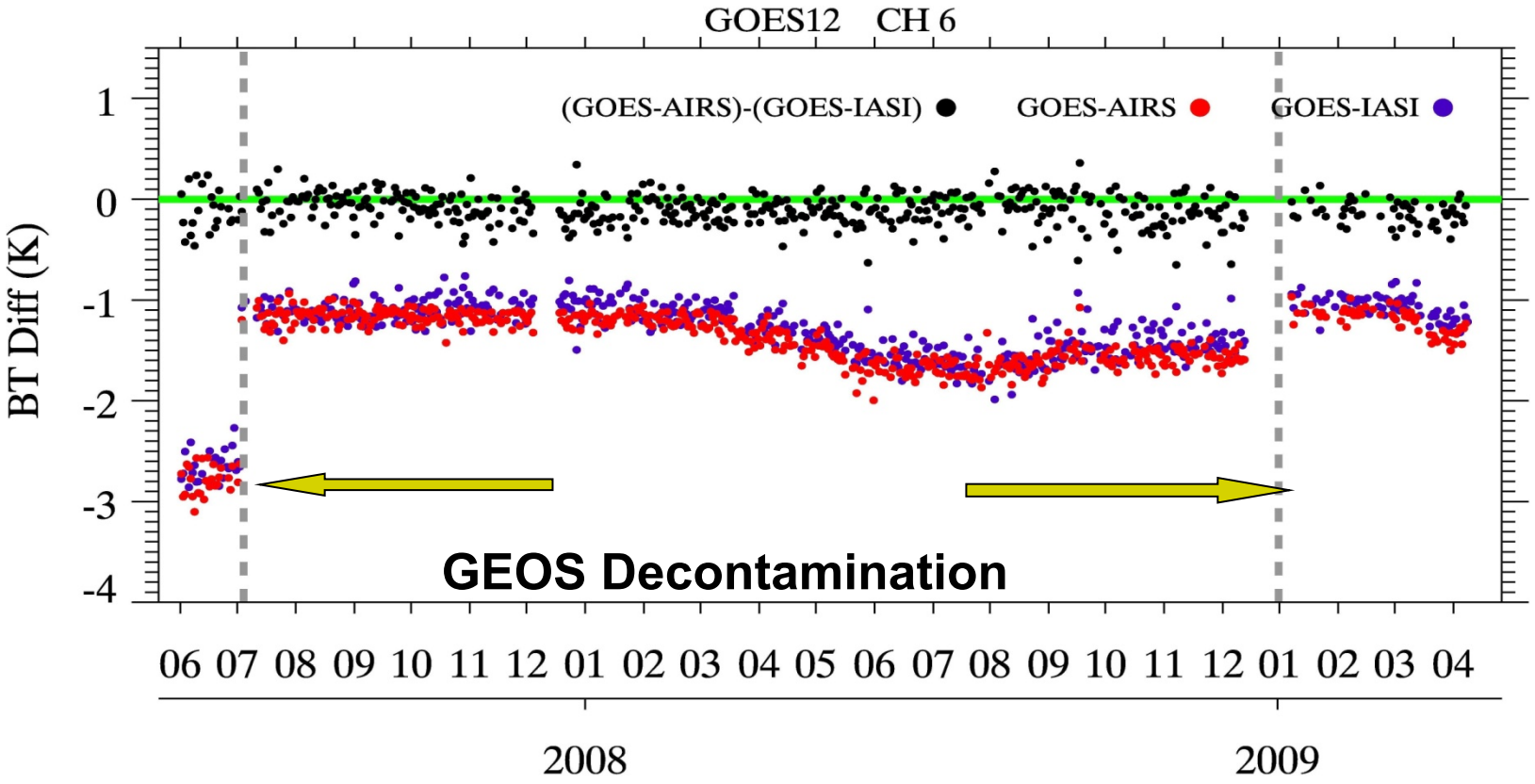


Goal 1: Routinely using AIRS/IASI to assess calibration accuracy of geostationary imager

Goal 2: Using comparison results to demonstrate consistency and relative stability of AIRS and IASI

Three-way comparison: Facilitate the instrument diagnosis

(Wang et al. 2009, JAMC)

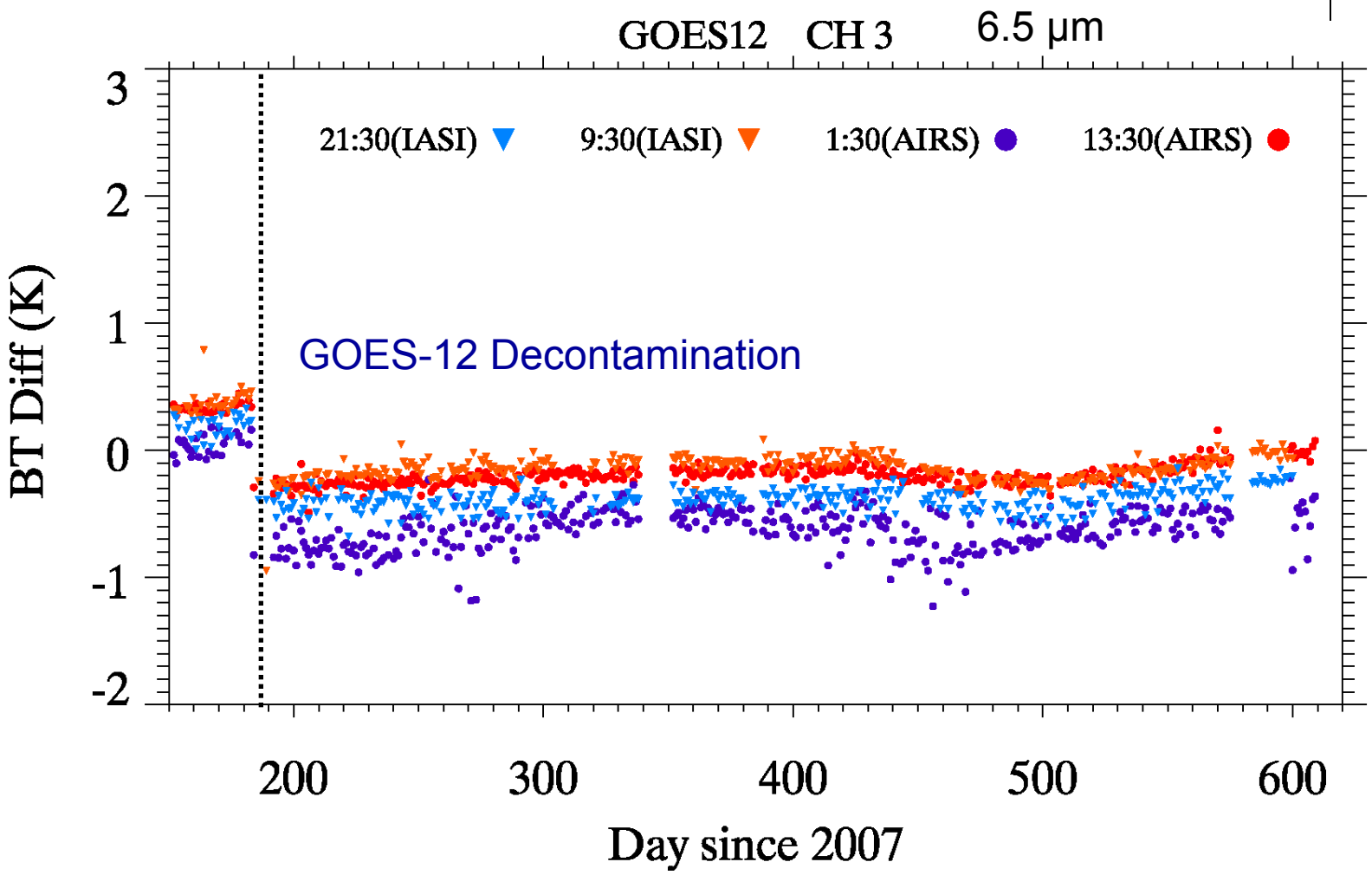


The bias between AIRS and GOES is relative

But IASI agrees with AIRS results, therefore the bias is likely in GOES!

Double difference can assess the consistency between IASI and AIRS.

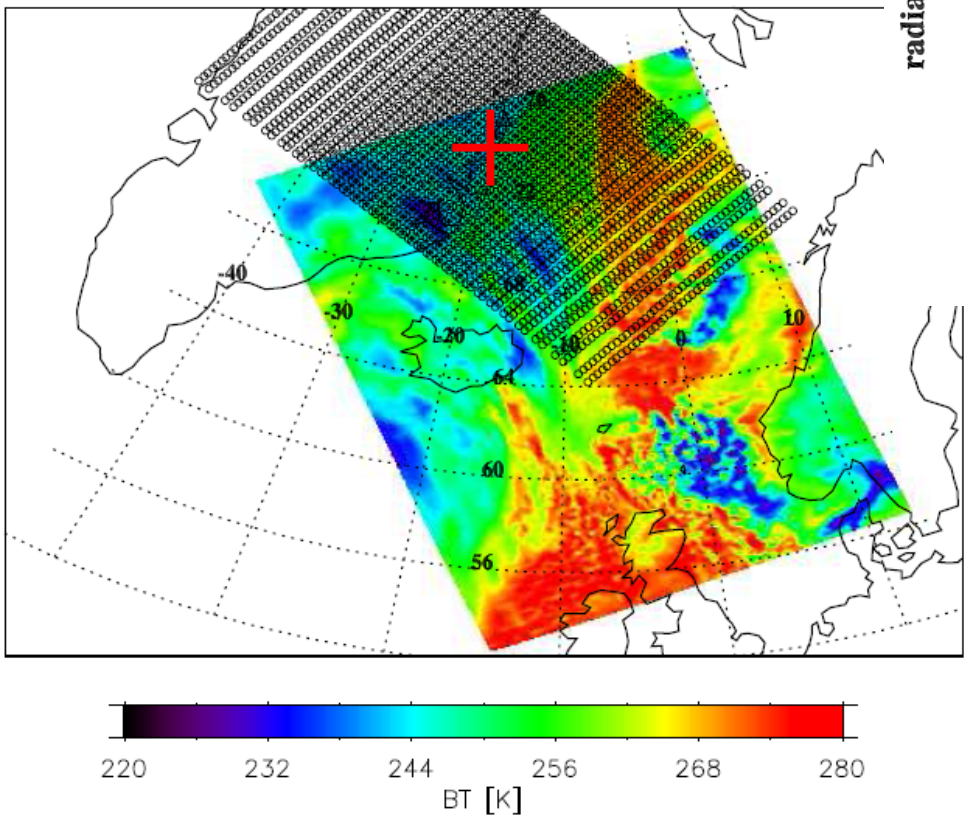
Diurnal variation of GOES Imager calibration accuracy

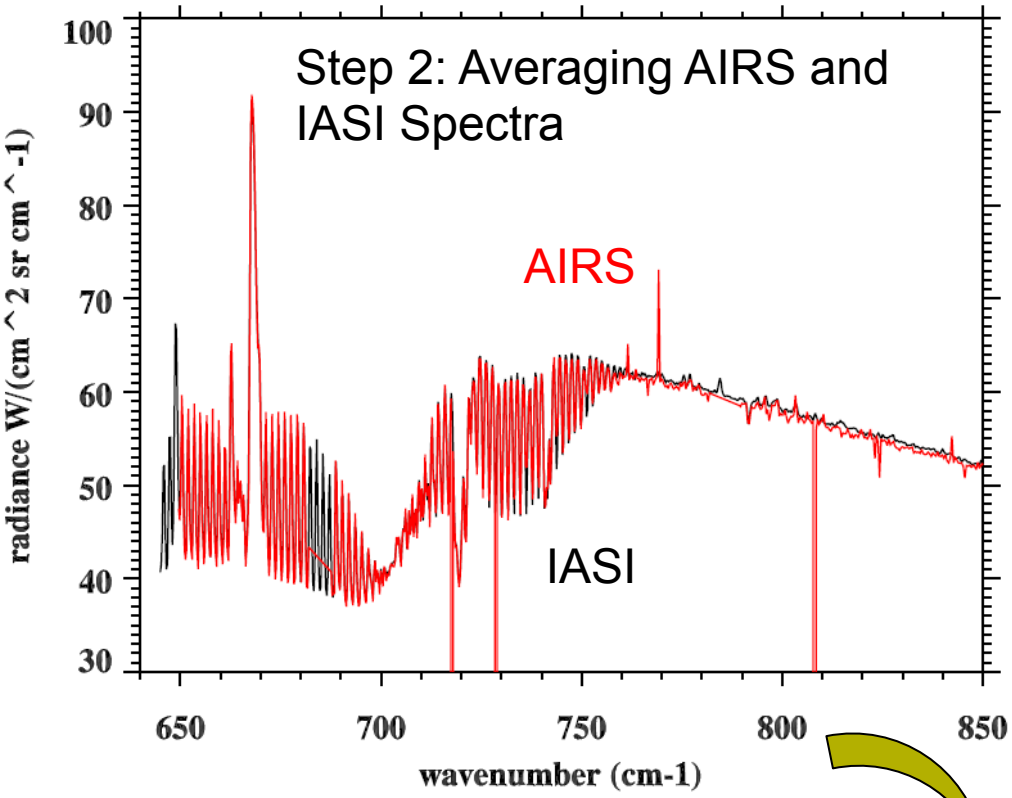


The stability of transfer target is important for double differences

SNO Method

Step 1: Pairing the SNO pixels between AIRS and IASI based on collocation criteria

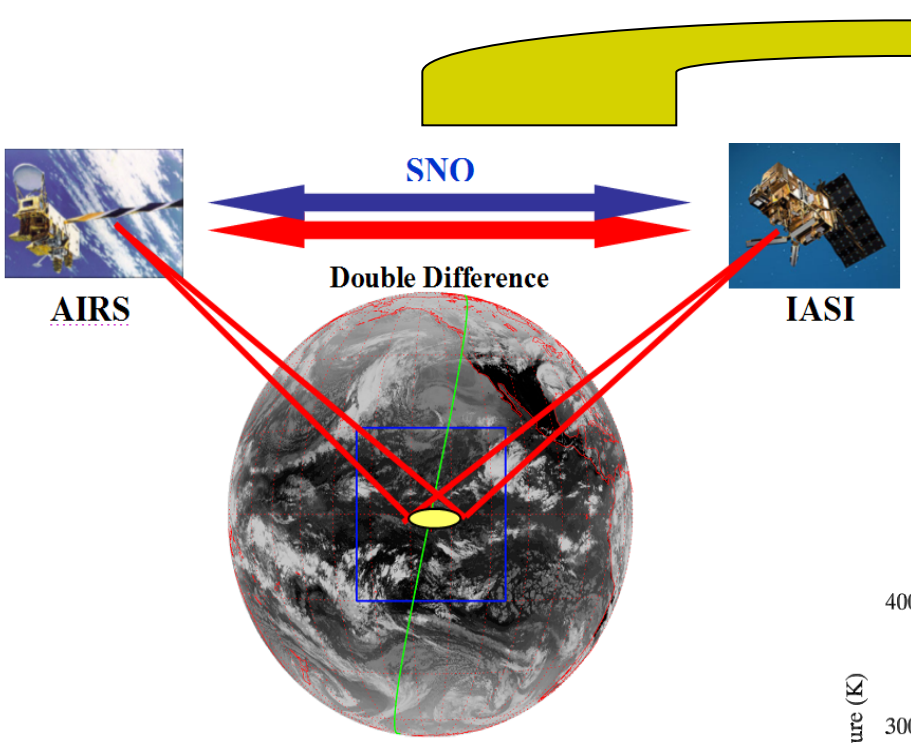




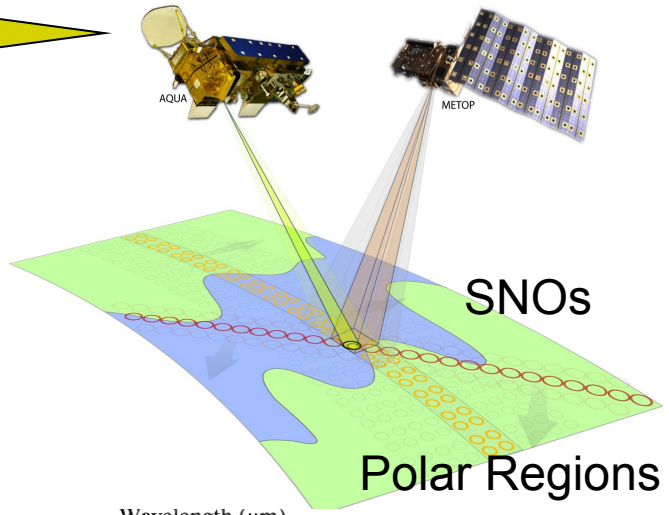
Step 3: Convolved with GOES imager SRFs

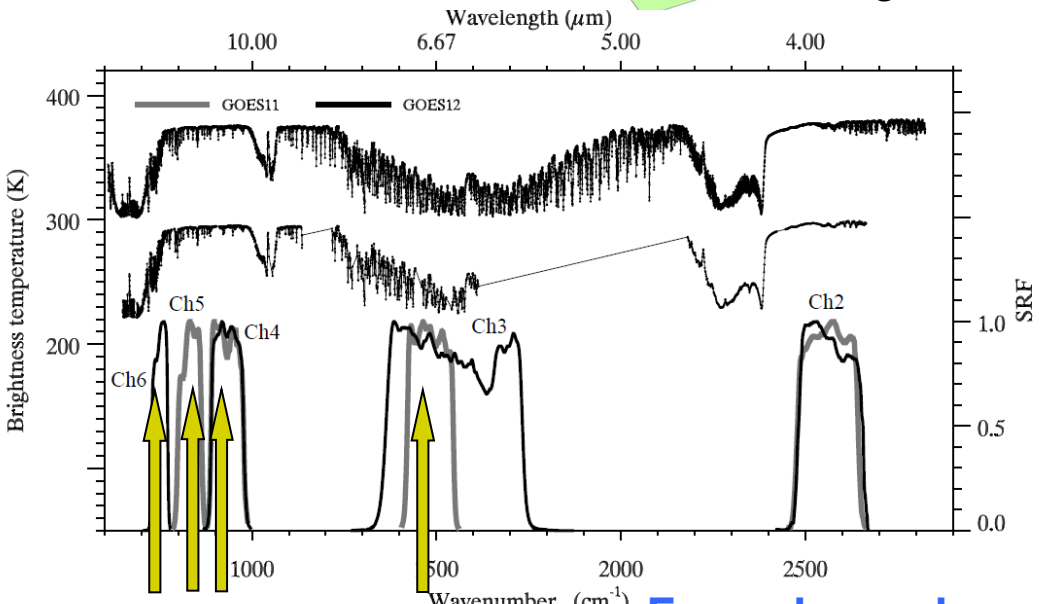
$$L_i = \frac{\int_{\nu_1}^{\nu_2} R(\nu) S_i(\nu) d\nu}{\int_{\nu_1}^{\nu_2} S_i(\nu) d\nu}$$

Double Difference versus SNOs



In the Tropics



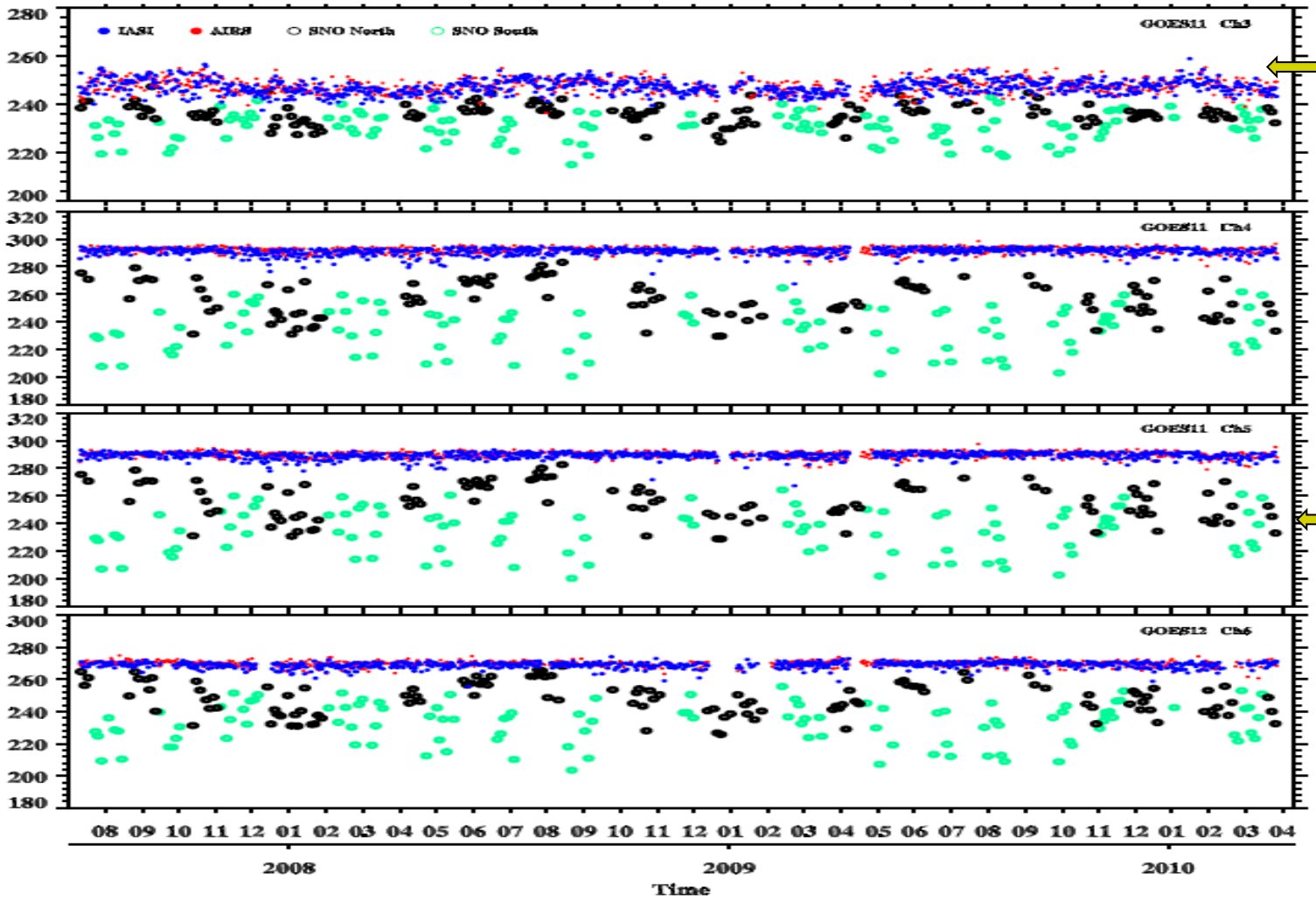


Four channels

1) Indirect vs. Direct comparison

2) Tropics vs. Polar Regions

Scene temperature: Double differences versus SNOs



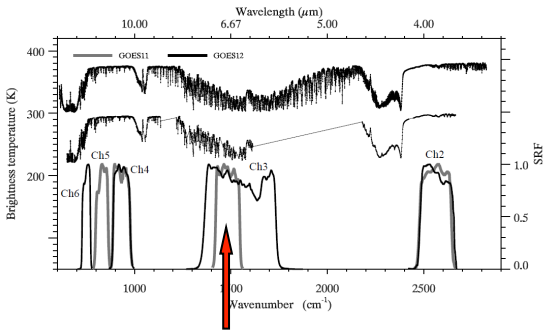
Double Differences

IASI-GOES
AIRS-GOES

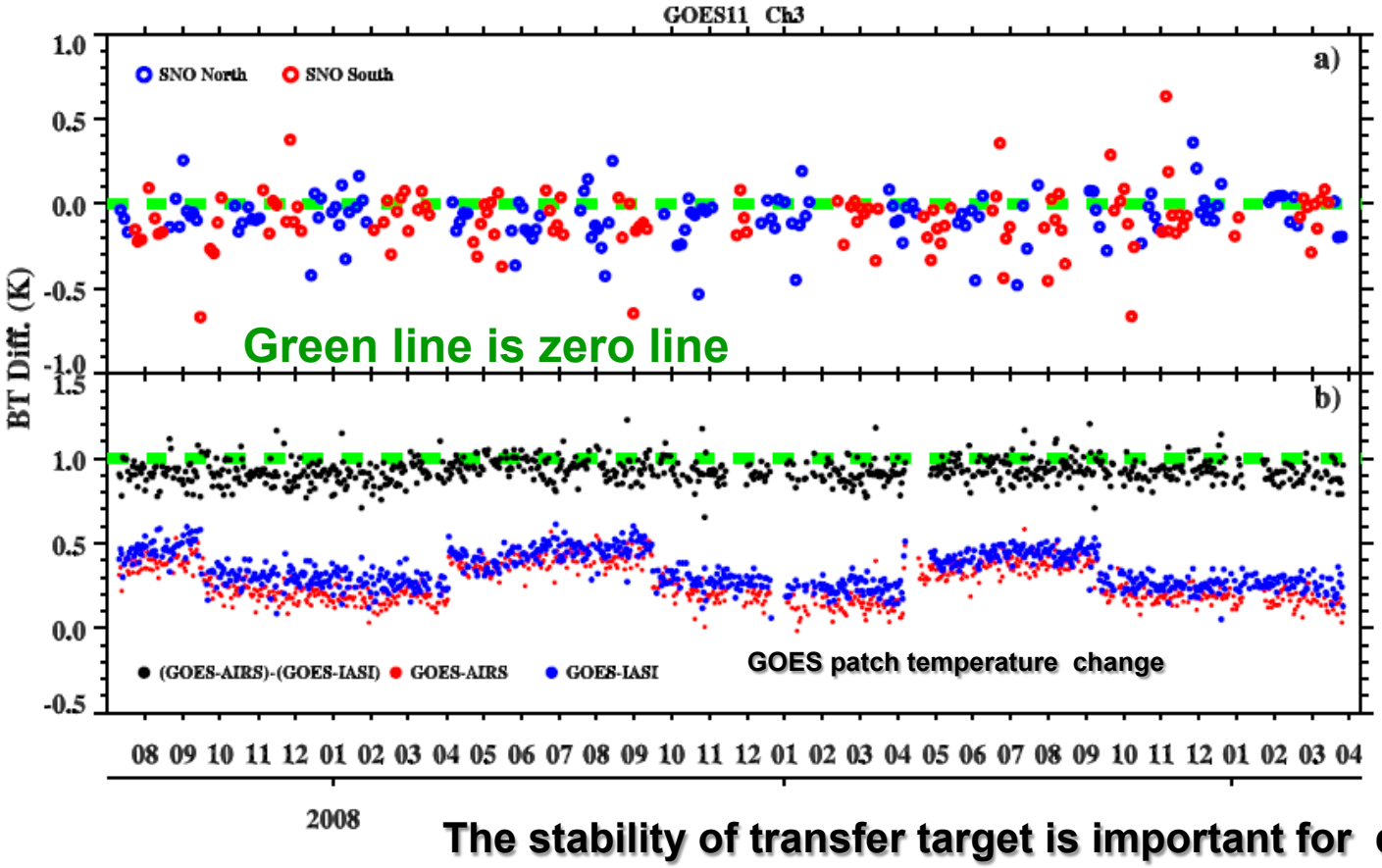
SNOs

North
South

Water vapor channel (6.7μm) (IASI-AIRS BT Difference)



SNO method has relatively large uncertainties.

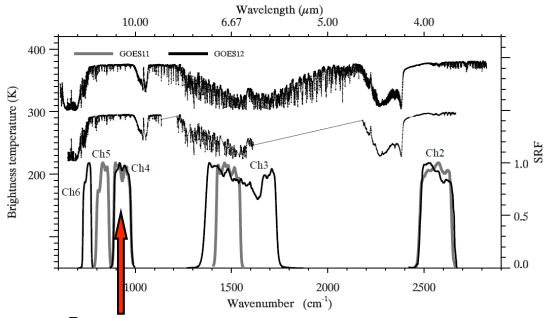


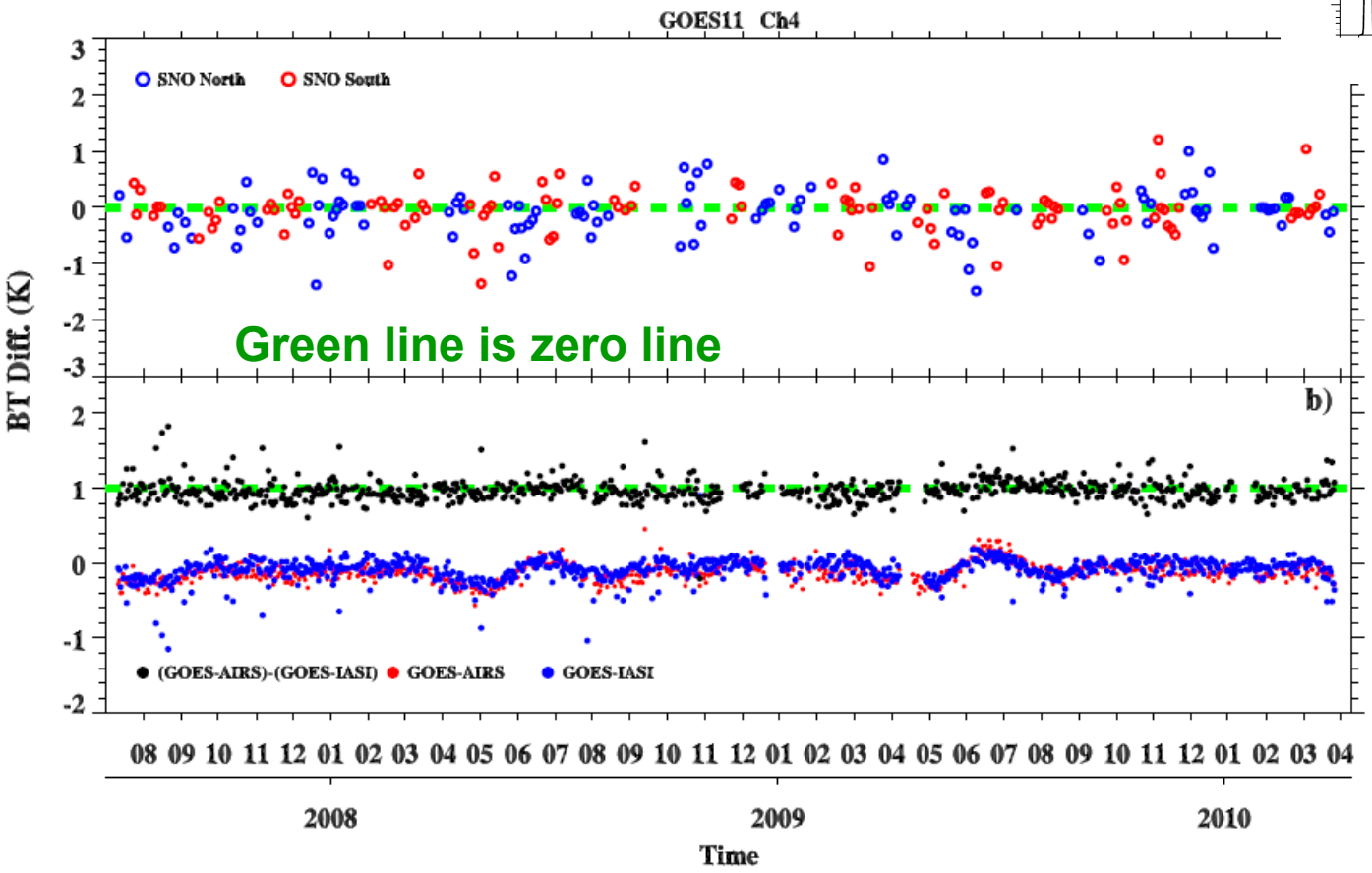
SNO method

Double differences

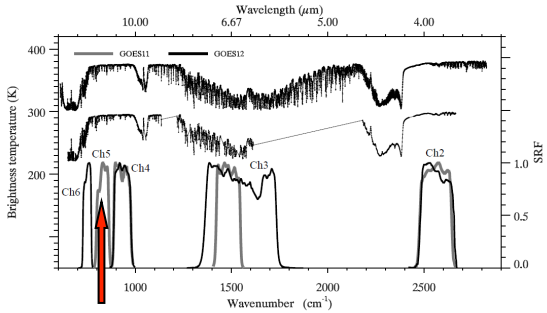
The stability of transfer target is important for double differences

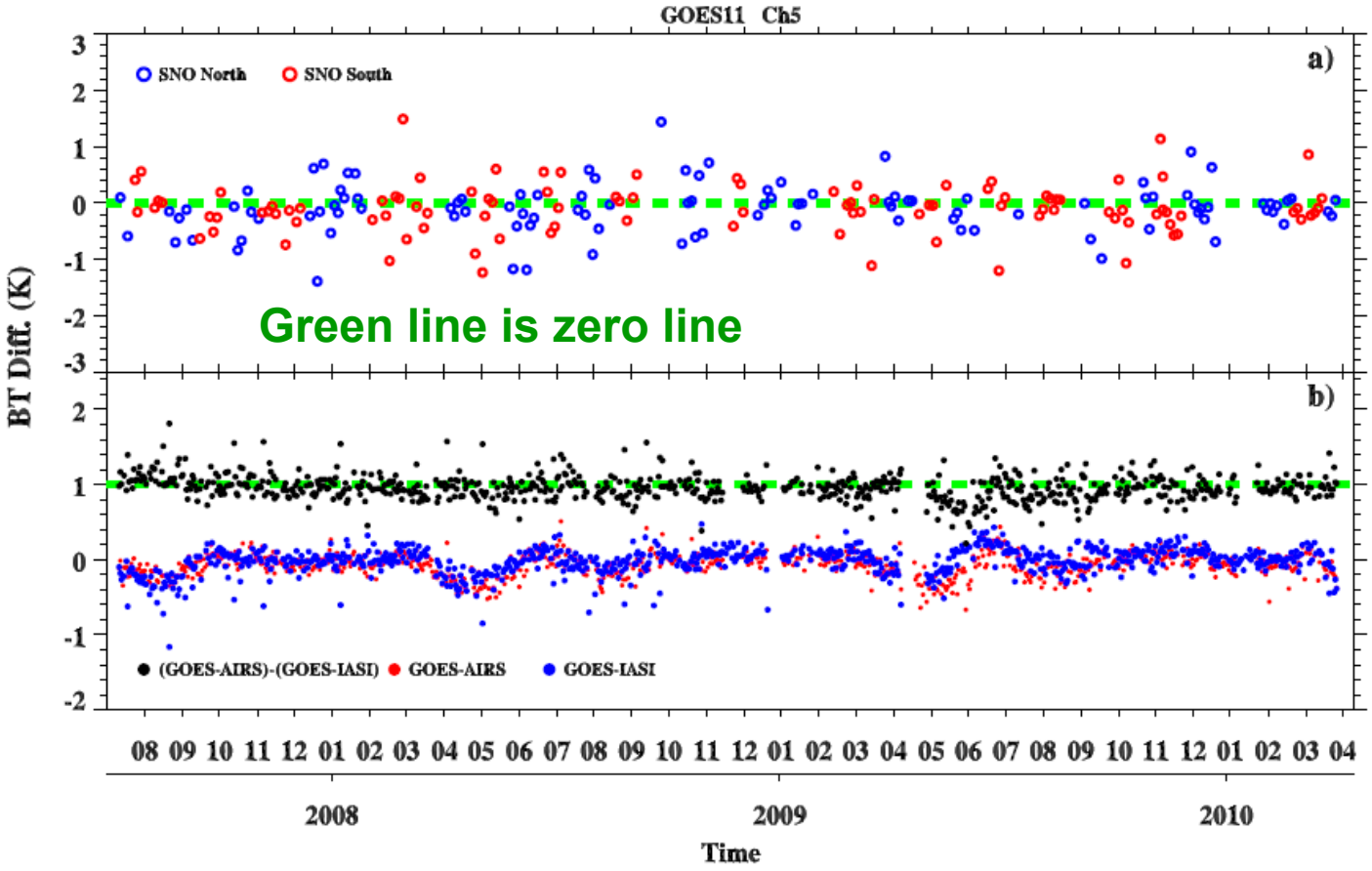
Window channel I (10.7μm)



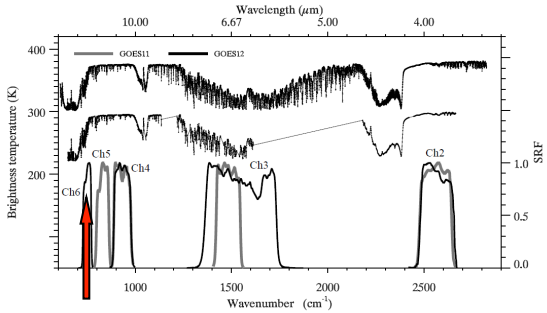


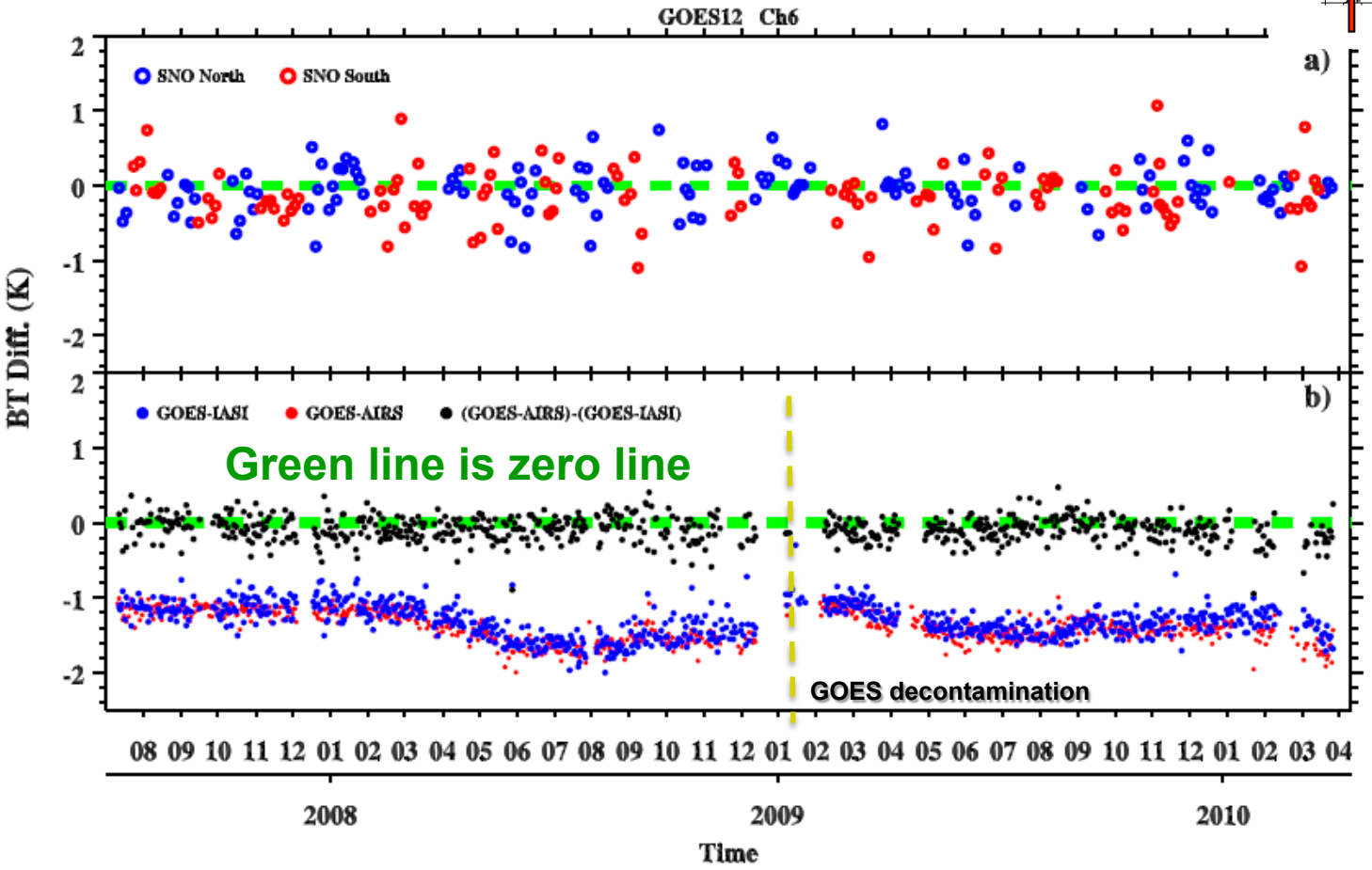
Window channel II (12.0 μm)



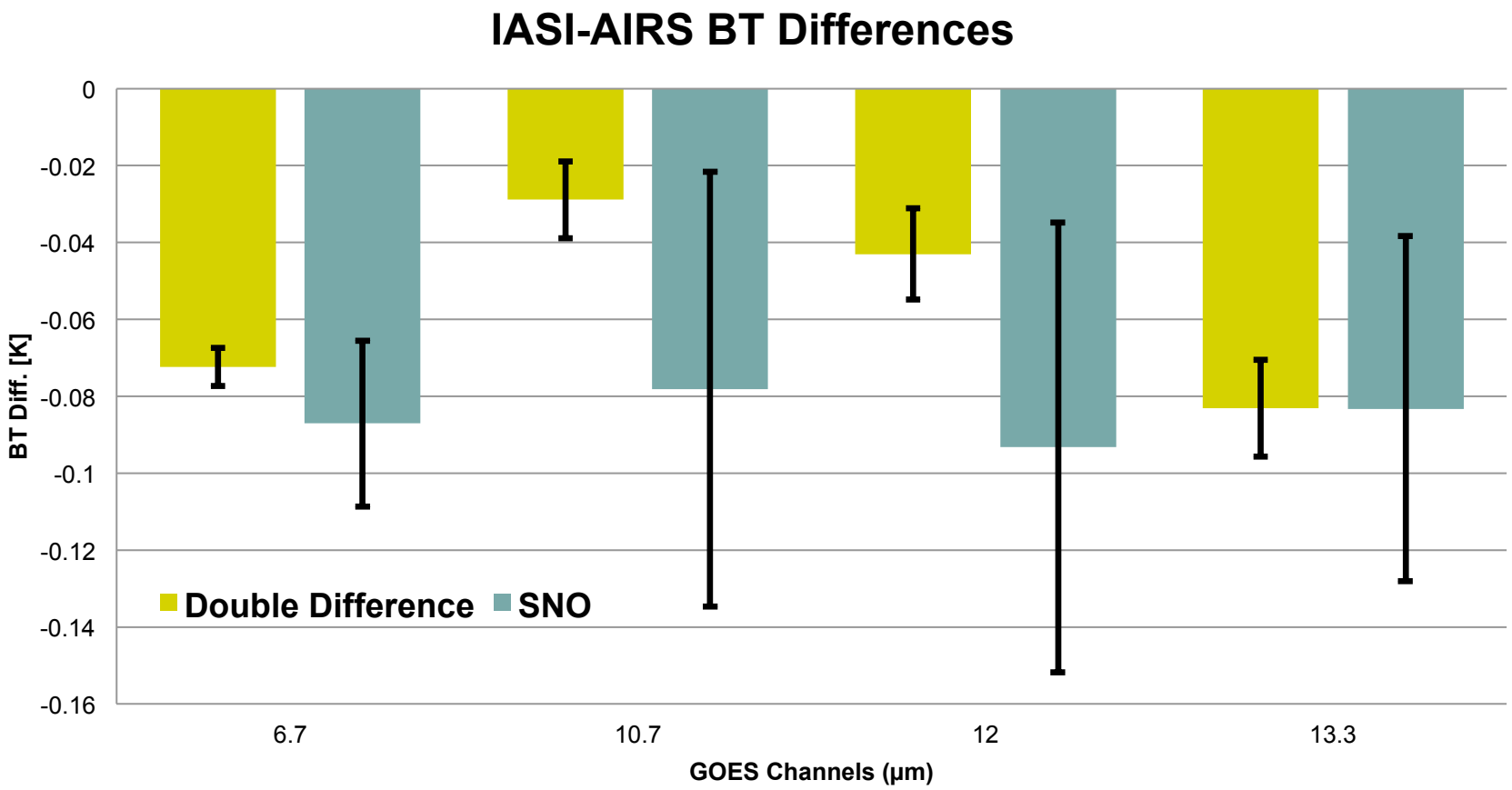


Sounding channel (13.3 μm)

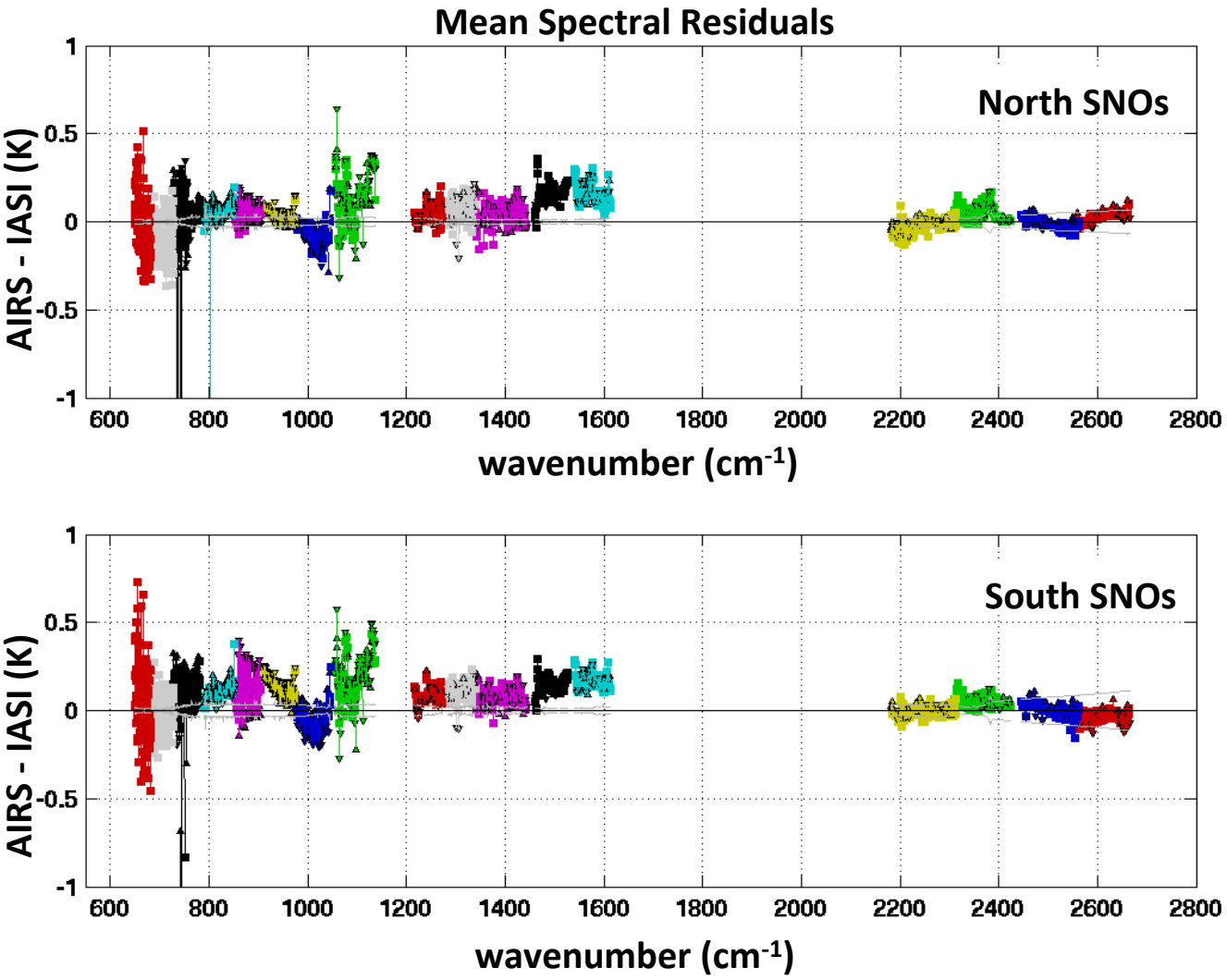




Final results



Tobin's SNO Results (AIRS-IASI BT difference)



Summary

- Focusing on different climate regions, the double difference and SNO methods allow assessing the IASI-AIRS radiance differences more comprehensively.
- Both methods reveal the good agreement between AIRS and IASI either in the Tropics or in the Polar regions, while their differences are less than 0.1 K and AIRS is slightly warmer than IASI.
- Future study will include the CrIS/NPP to link AIRS, IASI, and CrIS.
- Reference:
  - **Wang L.**, M, Goldberg, X. Wu, C. Cao, R. A. Iacovazzi Jr., F. Yu, Y. Li, 2011: Consistency assessment of AIRS and IASI radiances: Double differences versus simultaneous nadir overpasses. *Journal of Geophysical Research,* **116**, D11111, doi:10.1029/2010JD014988.
  - **Wang L.**, X. Wu, Y. Li, S.-H. Sohn, M. Goldberg, and C. Cao, 2010: Comparison of AIRS and IASI radiance measurements using GOES Imagers as transfer radiometers. *Journal of Applied Meteorology and Climatology*, **49**, 478-492.